



US009190691B2

(12) **United States Patent**  
**Goto**

(10) **Patent No.:** **US 9,190,691 B2**  
(45) **Date of Patent:** **Nov. 17, 2015**

(54) **FUEL CELL STACK**

(56) **References Cited**

(75) Inventor: **Sogo Goto**, Aichi-ken (JP)

U.S. PATENT DOCUMENTS

(73) Assignee: **Toyota Jidosha Kabushiki Kaisha**,  
Toyota-shi, Aichi-ken (JP)

2004/0115513 A1 6/2004 Yang  
2006/0024559 A1 2/2006 Benthem et al.  
2010/0273076 A1 10/2010 Kunitake

FOREIGN PATENT DOCUMENTS

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 307 days.

DE 11 2005 001 754 5/2007  
DE 11 2008 003 285 1/2011

(Continued)

OTHER PUBLICATIONS

(21) Appl. No.: **13/500,734**

International Preliminary Report on Patentability for PCT/JP2009/  
005386 filed Oct. 15, 2009.

(22) PCT Filed: **Oct. 15, 2009**

(Continued)

(86) PCT No.: **PCT/JP2009/005386**

§ 371 (c)(1),

(2), (4) Date: **Apr. 6, 2012**

*Primary Examiner* — Patrick Ryan

*Assistant Examiner* — Angela Martin

(74) *Attorney, Agent, or Firm* — Finnegan, Henderson,  
Farabow, Garrett & Dunner, LLP

(87) PCT Pub. No.: **WO2011/045839**

PCT Pub. Date: **Apr. 21, 2011**

(57) **ABSTRACT**

A fuel cell stack is equipped with a stacked body constituted by stacking a plurality of power generating elements, which contain an electrolytic membrane and electrocatalytic layers arranged at both surfaces of the electrolytic membrane, via a separator for providing a flow path for supplying reaction gas to the electrocatalytic layer, and collector plates arranged at both ends of the stacked body, for collecting electricity generated by the stacked body and outputting it to the outside, wherein on the separator and the collector plate are formed at least one of an anode exhaust gas exhaust hole for exhausting anode exhaust gas, a cathode exhaust gas exhaust hole for exhausting cathode exhaust gas, and a medium supply hole for supplying into the stacked body a medium for maintaining the temperature of the stacked body at an approximately fixed level, and at the anode side collector plate arranged at the anode side end of the stacked body, an output terminal for outputting at least part of the collected electricity to the outside is provided in the vicinity of at least one of the anode exhaust gas exhaust hole, the cathode exhaust gas exhaust hole, and the medium supply hole.

(65) **Prior Publication Data**

US 2012/0196203 A1 Aug. 2, 2012

(51) **Int. Cl.**

**H01M 8/24** (2006.01)

**H01M 8/02** (2006.01)

(52) **U.S. Cl.**

CPC ..... **H01M 8/241** (2013.01); **H01M 8/0267**  
(2013.01); **H01M 8/2465** (2013.01); **Y02E**  
**60/50** (2013.01)

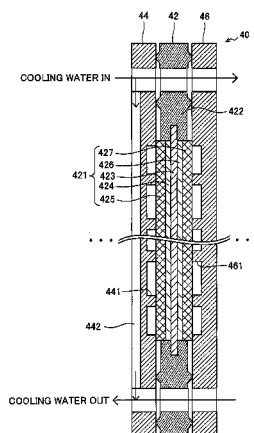
(58) **Field of Classification Search**

CPC . H01M 8/241; H01M 8/2425; H01M 8/2475;  
H01M 8/0202; H01M 8/04082; H01M  
8/04089

USPC ..... 429/454, 452, 457, 471, 455

See application file for complete search history.

**3 Claims, 6 Drawing Sheets**



(56)

**References Cited**

FOREIGN PATENT DOCUMENTS

JP	8-306380	11/1996	
JP	2004-186132	7/2004	
JP	2004-362943	* 12/2004	..... H01M 8/24
JP	2005-158431	* 6/2005	..... H01M 8/06
JP	2005-327558	11/2005	
JP	2006-73340	* 3/2006	..... H01M 8/04

JP	2007-26695	2/2007
JP	2009-117221	5/2009
JP	2009-218092	9/2009
WO	WO 2009/071968	* 6/2009

OTHER PUBLICATIONS

International Search Report in International Application No. PCT/  
JP2009/005386; Mailing Date: Jan. 12, 2010.

\* cited by examiner

Fig.1

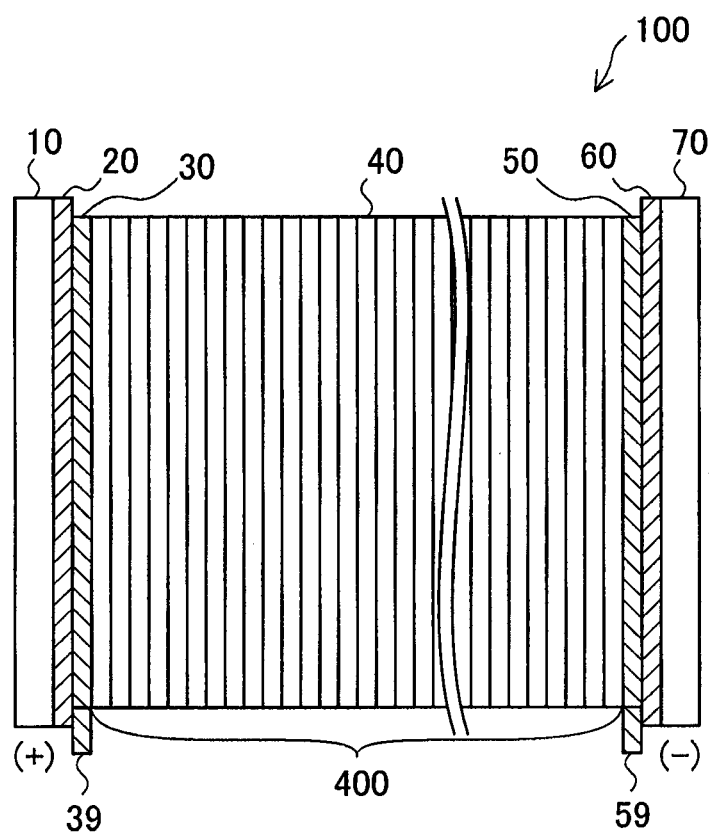


Fig.2

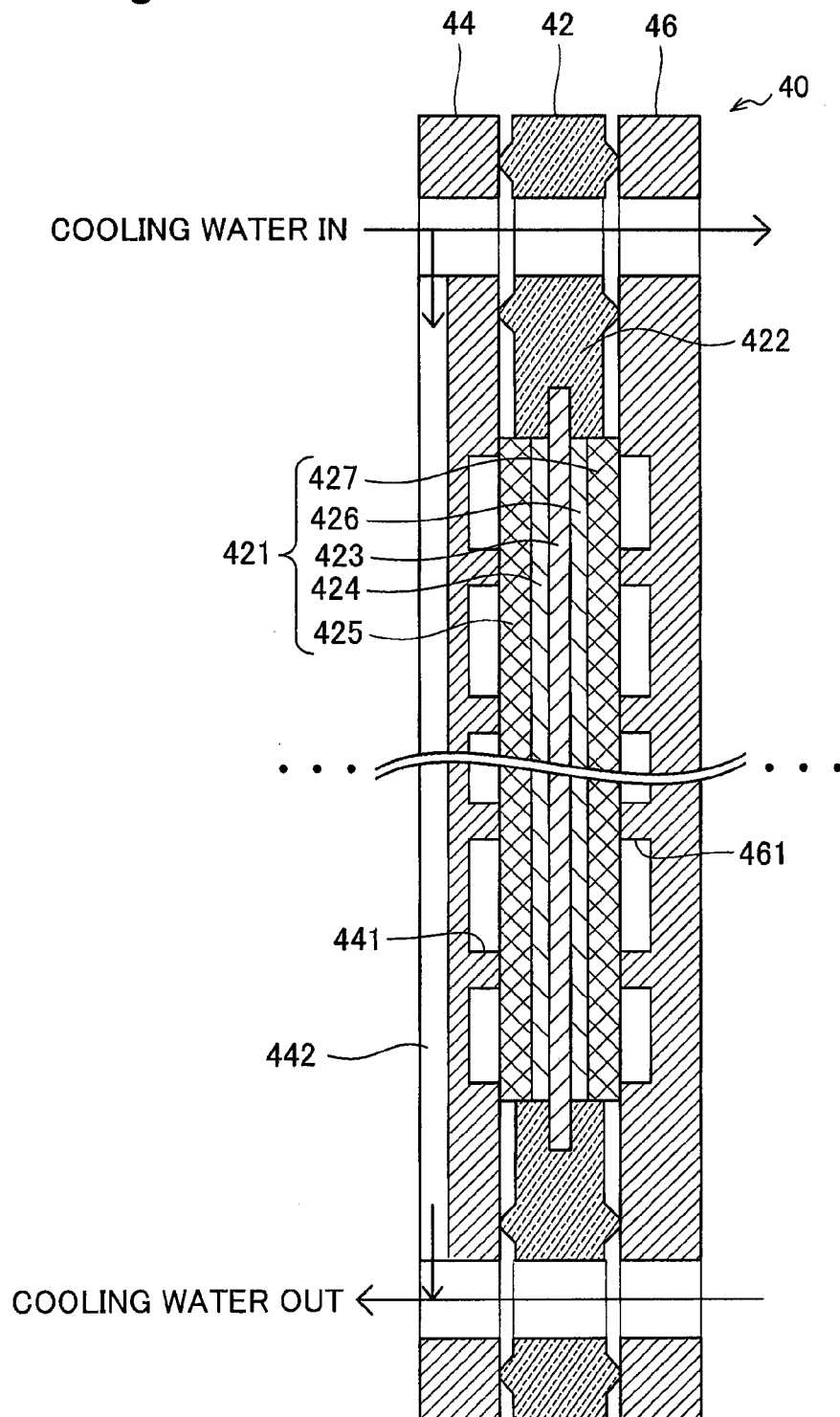


Fig.3

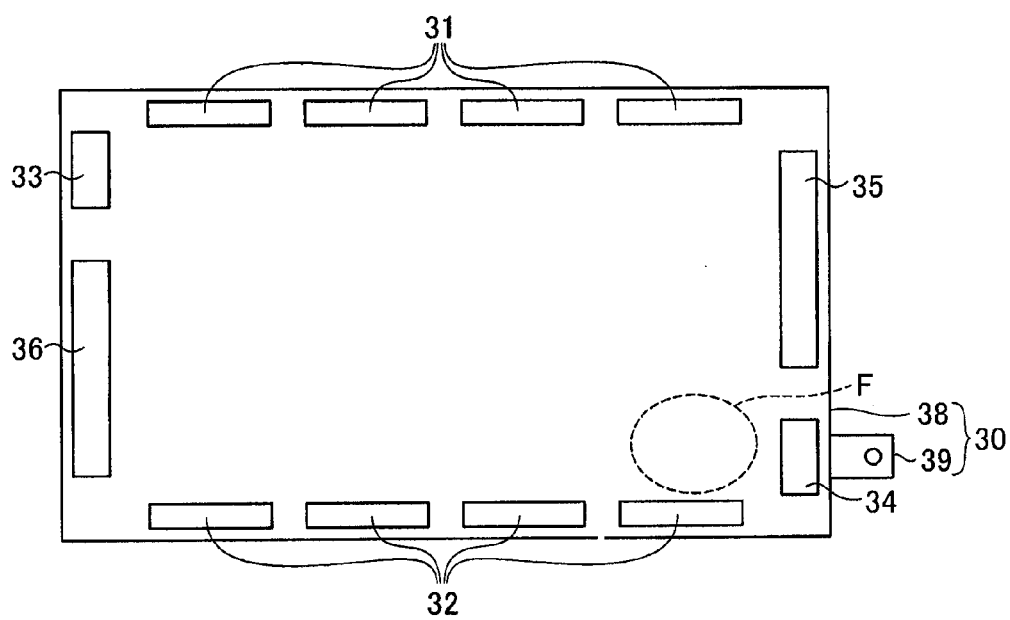


Fig.4

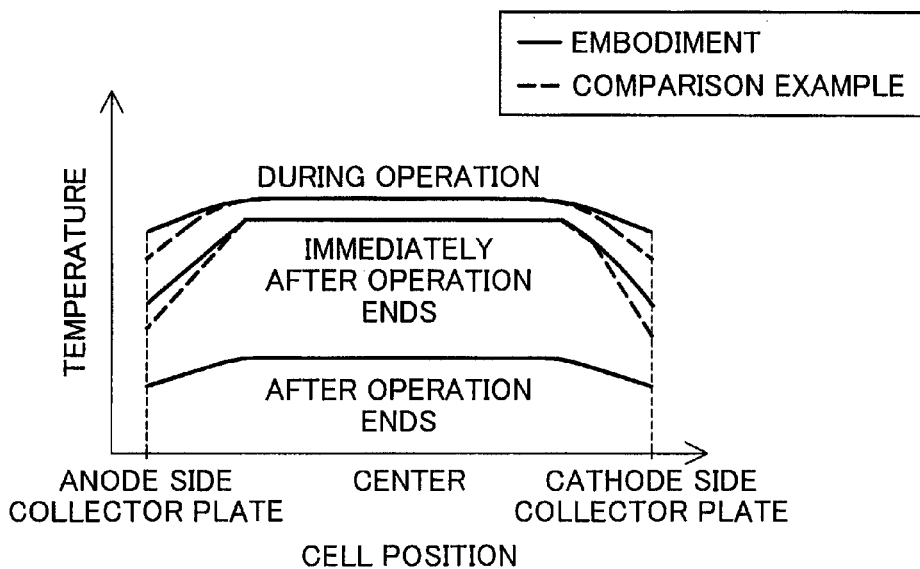


Fig.5

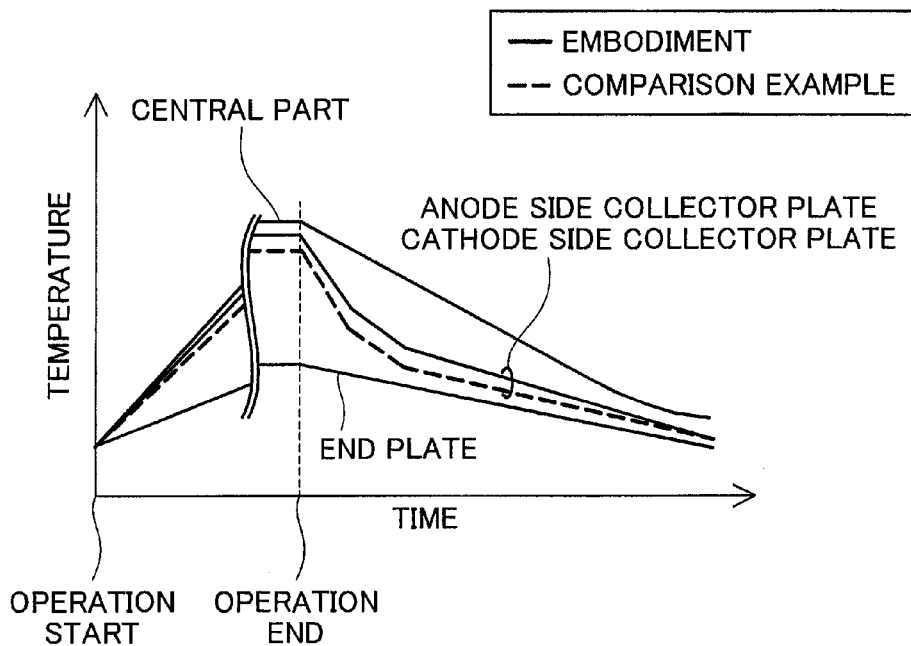


Fig.6A

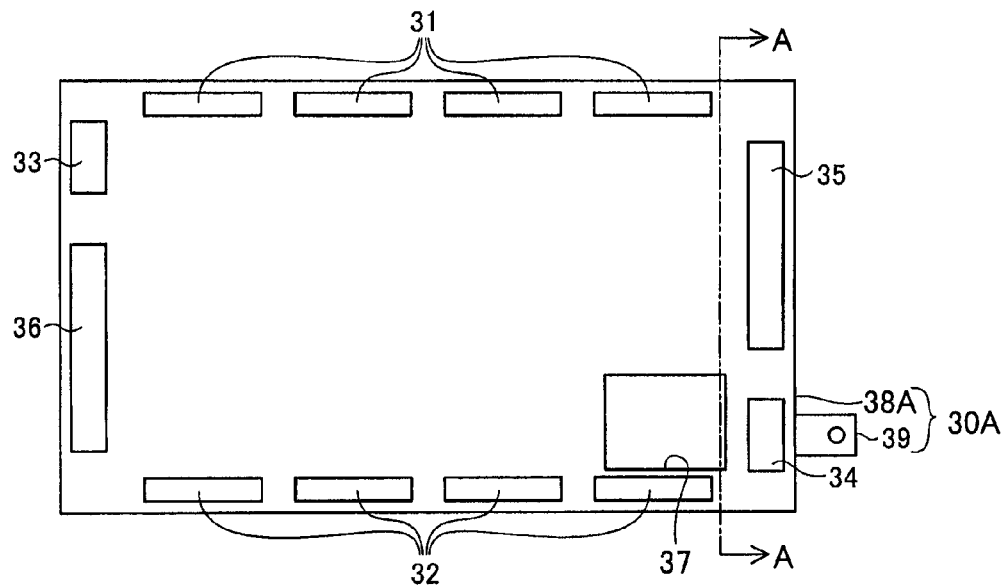


Fig.6B

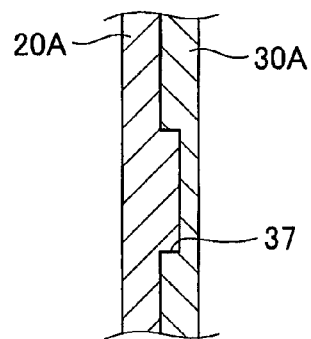


Fig.7

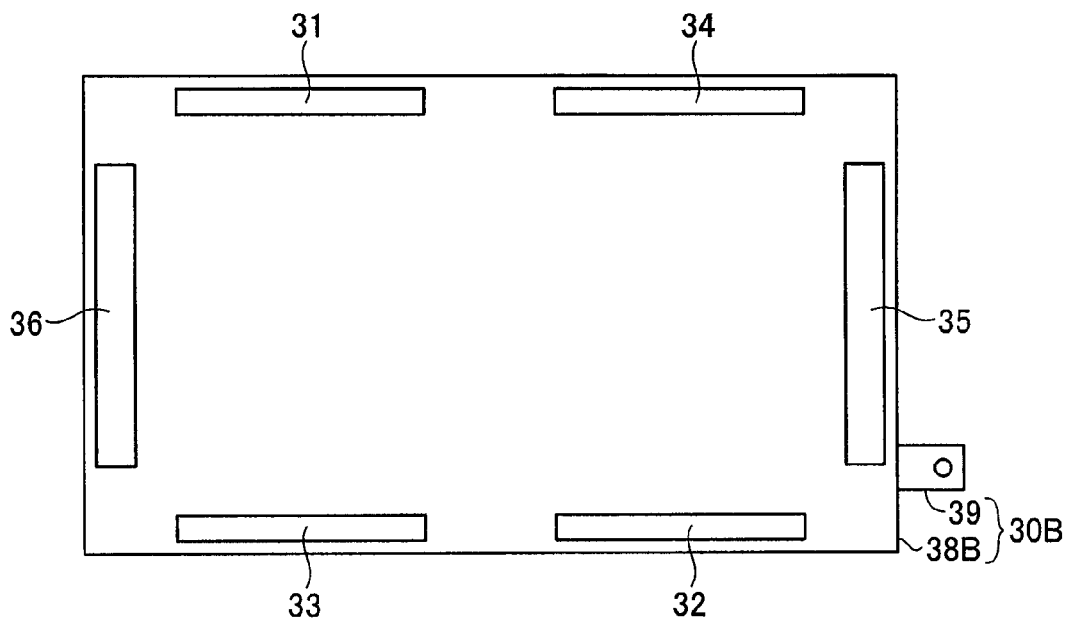
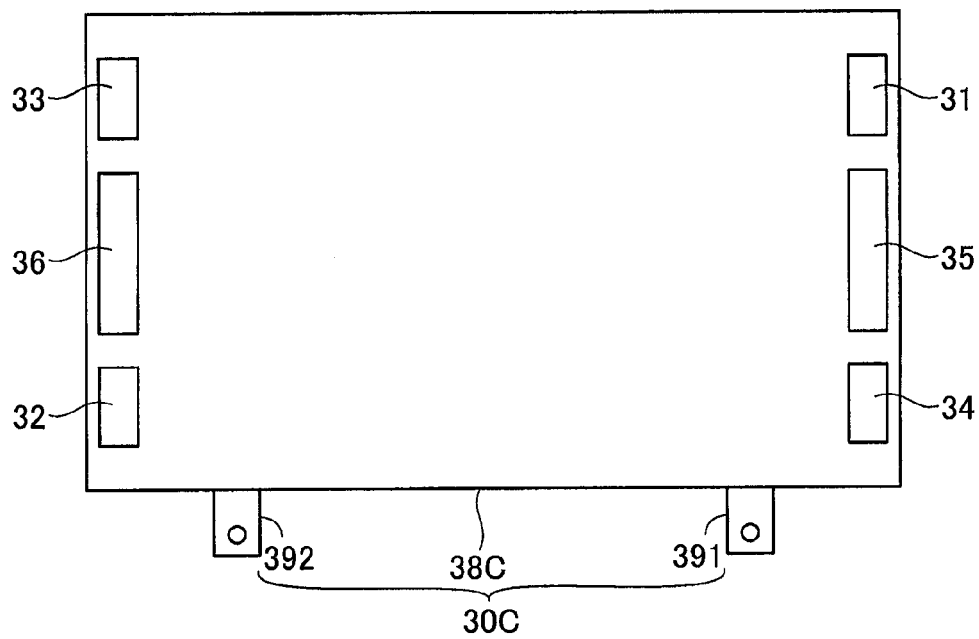


Fig.8





## 1

## FUEL CELL STACK

## TECHNICAL FIELD

The present invention relates to a fuel cell stack having a constitution for which a plurality of single cells are stacked.

## BACKGROUND ART

A fuel stack is normally constituted as a stacked body for which are stacked a plurality of single cells which contain a power generating element, which contains electrocatalytic layers arranged on both surfaces of the electrolytic membrane and electrolytic membrane, as well as a separator. With this fuel cell stack, at both ends of the stacked body are stacked in order a collector plate, an insulation plate, and an end plate, and the stacked state is maintained by fastening the pair of end plates using a fastener member. The end plates do not emit heat because they do not generate power, and also a large portion is in contact with air, so the heat dissipates even during operation of the fuel cell, so cooling occurs naturally. Because of that, a number of single cells positioned at the end part of the stacked body are cooled by heat conduction, and there was the problem that flooding occurred.

For this kind of problem, technology that smoothes the temperature distribution of the fuel cell stack using a heater during operation of the fuel cell stack has been proposed (see Patent Reference 1, for example).

## CITATION LIST

## Patent Literature

Patent Reference 1: JP-A-H08-306380  
Patent Reference 2: JP-A-2005-158431

## SUMMARY

## Problem the Invention Attempts to Solve

However, when using a constitution which provides a heater, there was the problem that the overall dimensions of the fuel cell stack become larger. Because of that, there was a desire to suppress flooding while suppressing the increasing size of the fuel cell stack.

## Means for Solving the Problem

The present invention was created to address the problem described above at in least part, and can be realized as the following modes or aspects.

[Aspect 1] A fuel cell stack comprising:

a stacked body constituted by stacking a plurality of power generating elements, which contain an electrolytic membrane and electrocatalytic layers arranged at both surfaces of the electrolytic membrane, via a separator for providing a flow path for supplying reaction gas to the electrocatalytic layer, and

collector plates arranged at both ends of the stacked body, for collecting electricity generated by the stacked body and outputting it to the outside, wherein

on the separator and the collector plate are formed at least one of an anode exhaust gas exhaust hole for exhausting anode exhaust gas, a cathode exhaust gas exhaust hole for exhausting cathode exhaust gas, and a medium supply hole

## 2

for supplying into the stacked body a medium for maintaining the temperature of the stacked body at an approximately fixed level,

and at the anode side collector plate arranged at the anode side end of the stacked body,

an output terminal for outputting at least part of the collected electricity to the outside is provided in the vicinity of at least one of the anode exhaust gas exhaust hole, the cathode exhaust gas exhaust hole, and the medium supply hole.

Flooding may occur near the cathode exhaust gas exhaust hole, the anode exhaust gas exhaust hole, and the medium supply hole. In particular, the degradation of the catalyst may result from flooding at the anode side. The output terminal emits heat due to electric resistance when outputting electricity. Therefore, with the anode side collector plate, by providing an output terminal near at least one of the cathode exhaust gas exhaust hole, the anode exhaust gas exhaust hole, and the medium supply hole, it is possible to heat the part at which flooding occurs easily, and to suppress flooding. By arranging in this way, it is possible to suppress flooding while suppressing the increased size to of the fuel cell stack.

[Aspect 2] A fuel cell according to application example 1 wherein

with the anode side collector plate, the electrical resistance per unit of length near the output terminal is in part greater than that of the remaining part.

By arranging in this way, the heat emission volume at the part for which flooding occurs easily becomes greater, so it is possible to suppress flooding more successfully.

[Aspect 3] A fuel cell according to application example 2 wherein

by forming the plate thickness near the output terminal to be in part thinner than the remaining part, the electrical resistance per unit of length becomes greater.

By arranging in this way, it is possible to easily increase the electrical resistance.

Note that the present invention can be realized in various modes, and for example can be realized in a mode as a fuel cell system equipped with the fuel cell stack noted above, or a vehicle equipped with that fuel cell system or the like.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view showing the schematic structure of a fuel cell stack as a first embodiment of the present invention;

FIG. 2 is an explanatory drawing schematically showing the cross section structure of a single cell;

FIG. 3 is a plan view showing the schematic planar structure of the anode side collector plate;

FIG. 4 is a graph showing the relationship between the cell position and temperature with the fuel cell stack;

FIG. 5 is a graph showing the changes over time in the temperature of the fuel cell stack;

FIG. 6 is a drawing schematically showing the anode side collector plate of a second embodiment;

FIG. 7 is a plan view showing the schematic structure of the anode side collector plate of modification 1; and

FIG. 8 is a plan view showing the schematic structure of the anode side collector plate of modification 2.

## MODES FOR CARRYING OUT THE INVENTION

## A. First Embodiment

## A1. Fuel Cell Stack Constitution

FIG. 1 is a plan view showing the schematic structure of a fuel cell stack **100** as a first embodiment of the present inven-

tion. The fuel cell stack **100** is a solid polymer type fuel cell for performing power generating using air as an oxidation gas and hydrogen as a fuel gas. The fuel cell stack **100** has a stacked body **400** for which are stacked a plurality of single cells **40** constituted with a sealing member single unit type MEA sandwiched by separators. Then, an anode side collector plate **30**, an insulation plate **20**, and an end plate **10** are stacked on the anode side end of the stacked body, and a cathode side collector plate **50**, an insulation plate **60**, and an end plate **70** are similarly stacked on the cathode side end. The fuel cell stack **100** is fastened and kept in a state with a specified pressure applied in the stacking direction using a tension plate or the like, though this is not illustrated. The number of single cell **40** stacking layers can be freely set according to the output required at the fuel cell stack **100**. Note that in FIG. 1, of the plurality of single cells **40** arranged between the anode side collector plate **30** and the cathode side collector plate **50**, a code number is given to one unit and is omitted for the remainder.

Provided on the fuel cell stack **100** piercing through in the stacking direction of the fuel cell stack **100** are an anode gas supply manifold, an anode exhaust gas exhaust manifold, a cathode gas supply manifold, a cathode exhaust gas exhaust manifold, a cooling water supply manifold, and a cooling water exhaust manifold. These manifolds are constituted by stacking the aforementioned sealing member single unit type MEA, separators, end plates **10** and **70**, insulation plates **20** and **60**, anode side collector plate **30**, and cathode side collector plate **50**, and by providing through holes respectively in each of these. With this embodiment, as a cooling medium, cooling water is used, it is also possible to use another cooling medium such as ethylene glycol, propylene glycol or the like.

To ensure rigidity, the end plates **10** and **70** are formed using a metal such as copper or the like. Stainless steel is used for the anode side collector plate **30** and the cathode side collector plate **50**, instead of stainless steel, it is also possible to use other metals such as titanium, aluminum or the like, or a gas impermeable conductive member such as fine carbon or the like. The insulation plates **20** and **60** are formed using an insulation member such as rubber, resin, or the like. Output terminals **39** and **59** are respectively provided on the anode side collector plates **30** and **50**, making it possible to output the power generated by the fuel cell stack **100**.

FIG. 2 is an explanatory drawing schematically showing the cross section structure of a single cell **40**. The single cell **40** has an anode side separator **44** and a cathode side separator **46** respectively arranged at both surfaces of a sealing member single unit type MEA **42**.

The sealing member single unit type MEA **42** has a frame shaped sealing member **422** formed as a single unit with an MEA **421** on the outer circumference of the MEA **421** for which the outer shape is a roughly rectangular shape. The MEA **421** is constituted by stacking in order an anode **424** and an anode side diffusion layer **425** on one surface of an electrolytic membrane **423**, and stacking in order a cathode **426** and a cathode side diffusion layer **427** on the other surface.

With this embodiment, a polyelectrolyte membrane formed using a fluorine resin is used as the electrolytic membrane **423**. As the anode **424** and the cathode **426**, electrodes formed from a carbon carrier supporting platinum and a platinum alloy as a catalyst are used. As the anode side diffusion layer **425** and the cathode side diffusion layer **427**, water repellent processed carbon felt is used. With this embodiment, to increase the drainage, water repellent processing is implemented on the anode side diffusion layers **425** and **216c**, it is also possible to use a constitution for which water repellent processing is not implemented. The sealing member **422**

is formed with an injection mold using silicone rubber. The material of each part constituting the sealing member single unit type MEA **42** is not limited to that in this embodiment, and it is possible to use various types of known materials.

Formed on the surface abutting the anode side diffusion layer **425** of the anode side separator **44** is an anode gas flow path **441** for distributing and flowing anode gas in the surface direction of the anode side diffusion layer **425**, and formed on the other side is a cooling water flow path **442** for flowing cooling water. Meanwhile, formed on the surface abutting the cathode side diffusion layer **427** of the cathode side separator **46** is a cathode gas flow path **461** for distributing and flowing cathode gas in the surface direction of the cathode side diffusion layer **427**. With this embodiment, stainless steel is used for the anode side separator **44** and the cathode side separator **46**. The separator material is not limited to that in this embodiment, and it is also possible to use other metals such as titanium, aluminum or the like, a gas impermeable conductive member such as fine carbon or the like.

Note that the constitution of the separator is not limited to that in to this embodiment, and it is possible to use separators of various constitutions. For example, it is also possible to use a constitution for which the anode gas flow path and the cathode gas flow path are respectively formed on both surfaces of one separator. It is also possible to use a porous body as the gas flow path and to use a three-layer constitution separator equipped with a smooth surface facing opposite the porous body and equipped with a cooling water flow path on the interior.

FIG. 3 is a plan view showing the schematic planar structure of the anode side collector plate **30**. The anode side collector plate **30** is equipped with a collector unit **38** and an output terminal **39**. The collector unit **38** is a flat plate shape forming an approximately rectangular shape with the same outer shape as the outer shape of the single cell **40**, and on its circumferential edge part are formed the anode gas supply through hole **33**, the anode exhaust gas exhaust through hole **34**, the cathode gas supply through hole **31**, the cathode exhaust gas exhaust through hole **32**, the cooling water supply through hole **35**, and the cooling water exhaust through hole **36** which constitute the aforementioned anode gas supply manifold, the anode exhaust gas exhaust manifold, the cathode exhaust gas exhaust manifold, the cathode gas supply manifold, the cooling water supply manifold, and the cooling water exhaust manifold.

The output terminal **39** is electrically connected for example to a secondary cell or an outside load device such as a drive motor or the like for running a vehicle, and is a terminal for outputting electricity generated by the fuel cell stack **100** and supplying it to an outside load. The output terminal **39** is provided in the vicinity of the anode exhaust gas exhaust through hole **34**, in the vicinity of the cathode exhaust gas exhaust through hole **32**, and in the vicinity of the cooling water supply through hole **35**.

The output terminal **39** cross section area is smaller than that of the collector unit **38**, so the heat emitting heat volume when outputting electricity generated at the fuel cell stack **100** is greater than that of the collector unit **38**. Therefore, with the anode side collector plate of this embodiment, within the plane of the collector unit **38**, the temperature in the vicinity of the output terminal **39** becomes higher than in other areas.

With this embodiment, the output terminal **59** of the cathode side collector plate **50** is also provided at the same location as the anode side collector plate **30**.

## A2. Effect of the Embodiment

We will compare the effect of this embodiment with a comparison example and describe it based on FIGS. 4 and 5.

5

With the fuel cell stack **100** of this embodiment, the output terminal **39** of the anode side collector plate **30** is provided near the anode exhaust gas exhaust through hole **34**, in contrast to which, with the fuel cell stack of the comparison example, the output terminal of the anode side collector plate is provided near the anode gas supply through hole **33**. Specifically, the output terminal **39** of this embodiment is arranged in the vicinity of the area F shown surrounded by dotted lines in FIG. 3, in contrast to which the output terminal of the comparison example is not arranged in the vicinity of the area F. The fuel cell stack of the comparison example has the same constitution as the constitution of the fuel cell stack **100** of this embodiment except for the fact the output terminal arrangement differs from that of the fuel cell stack **100** of the present invention.

FIG. 4 is a graph showing the relationship between the cell position and temperature with the fuel cell stack. FIG. 5 is a graph showing the changes over time in the temperature of the fuel cell stack. The temperature is measured in the area corresponding to the area F for all the single cells and the collector plate. In FIGS. 4 and 5, the temperature changes with the fuel cell stack **100** of this embodiment are shown with a solid line, and the temperature changes with the fuel cell stack of the comparison example are shown with a dotted line.

During operation and immediately after operation of the fuel cell stack **100** of this embodiment, the area F temperature with the anode side collector plate **30** and the cathode side collector plate **50** is higher than that of the comparison example, and the single cell temperature near the end part of the stacked body is high (FIGS. 4 and 5). Because of that, with the fuel cell stack **100** of this embodiment, it is possible to suppress flooding more than with the comparison example.

Typically, with the fuel cell stack, it is easy for water (including water vapor and liquid water) to pool near the anode exhaust gas exhaust through hole, the cathode exhaust gas exhaust through hole, and the cooling water supply through hole. Specifically, it is easy for water to pool in the area corresponding to the area F on the inside of the single cell. With the fuel cell stack **100** of this embodiment, it is thought that flooding is effectively suppressed because the output terminal **39** is provided near the area F at which water pools easily (FIG. 3).

Also, with the fuel cell stack **100** of this embodiment, it is possible to suppress degradation of the catalyst at the anode of the single cell **40** arranged near the anode side collector plate **30**. The reason for this is thought to be as follows.

When flooding occurs at the anode side of the single cell **40**, hydrogen is not supplied to the part at which flooding has occurred, so a reaction ( $C+2H_2O \rightarrow CO_2+4H^++4e^-$ ) that generates a proton from the carbon in the catalyst and water occurs, and there is the risk that the catalyst will degrade. Typically, with the fuel cell stack, with the single cells near the anode side collector plate, since the anode side is lower temperature than the cathode side (FIG. 4), water moves from the cathode side to the anode side, and flooding occurs at the anode side. With the single cells near the cathode side collector plate, flooding does not occur easily at the anode side.

With the fuel cell stack **100** of this embodiment, by providing the output terminal **39** of the anode side conductor plate **30** near the area F, the temperature of the area F of the anode side collector plate **30** rises more than with the comparison example, and the temperature difference between electrodes with the single cells near the anode side collector plate **30** is smaller than with the comparison example (FIGS. 4 and 5). As a result, with the single cells near the anode side collector plate **30**, movement of water from the cathode side to the anode side is suppressed, and flooding at the anode side

6

is suppressed. Therefore, it is possible to suppress degradation of the catalyst due to lack of hydrogen at the anode side.

Note that with the fuel cell stack **100**, there is a great deal of water at the cathode side with the single cells near the cathode side collector plate **50**. When flooding occurs at the cathode side, air is not supplied, so there is the risk that the cell voltage will decrease. In contrast to this, with this embodiment, even with the cathode side collector plate **50**, the output terminal **59** is provided in the vicinity of the area for which flooding occurs easily, so flooding is prevented at the cathode side, and it is possible to suppress a decrease in the cell voltage.

Furthermore, with the fuel cell stack **100** of this embodiment, it is possible to suppress flooding without providing a heating means such as a heater or the like, so it is possible to suppress flooding while suppressing an increase in size of the fuel cell stack. Also, for example when using a constitution for which a heater is provided, power is required to drive the heater and the control device for controlling the heater, and there is the problem that the use efficiency of the power generated with the fuel cell stack decreases. On the other hand, with the fuel cell stack **100** of this embodiment, compared to when a heater is provided, it is possible to increase the use efficiency of the power generated by the fuel cell stack.

## B. Second Embodiment

The fuel cell stack of the second embodiment is the same as the first embodiment except for the constitution of the anode side conductor plate, so we will describe the anode side conductor plate, and omit a description of the remainder of the constitution. FIG. 6 is a drawing schematically showing the anode side collector plate of the second embodiment. FIG. 6(a) is a plan view, and (b) is a cross section view showing the A-A cross section in (a).

The anode side conductor plate **30A**, the same as with the anode side conductor plate **30** with the first embodiment, is equipped with a collector unit **38A** and the output terminal **39**. The collector unit **38A** with this embodiment forms an outer shape that is approximately rectangular the same as with the collector unit **38** of the first embodiment, and the cathode gas supply through hole **31**, the cathode exhaust gas exhaust through hole **32**, the anode gas supply through hole **33**, the anode exhaust gas exhaust through hole **34**, the cooling water supply through hole **35**, and the cooling water exhaust through hole **36** are arranged in the same way as with the first embodiment. Also, the output terminal **39** is arranged in the same position as with the first embodiment.

The difference between the collector unit **38A** of this embodiment and the collector unit **38** of the first embodiment is the point that a high electrical resistance area **37** is provided in the vicinity of the output terminal **39**. As shown in FIG. 6(B), the high electrical resistance area **37** has a thinner plate thickness than the remaining area. The electrical resistance is inversely proportional to the cross section area. Therefore, with the collector unit **38A**, the electrical resistance per unit of length of the high electrical resistance area **37** is greater than that of the remaining area. Therefore, when the electricity generated by the fuel cell stack is fetched via the output terminal **39**, the heat volume generated by the electricity that flows in the high electrical resistance area **37** is greater than that of the remaining area. Therefore, it is possible to further heat the area for which flooding occurs easily, making it possible to suppress the occurrence of flooding.

Note that with the fuel cell stack of this embodiment, the area facing opposite the high electrical resistance area **37** of

the insulation plate 20A is formed in a projecting state so as to engage with the high electrical resistance area 37 (FIG. 6 (B)). By arranging in this way, it is possible to suppress the decrease in pressing force in the stacking direction of the fuel cell stack at the high electrical resistance area 37.

### C. Modifications

Note that this invention is not limited to the embodiments noted above, and it is possible to implement various modes in a scope that does not stray from its gist, with the following modifications possible, for example.

#### C1. Modification 1:

The arrangement of the output terminal 39 at the anode side collector plate 30 is not limited to the aforementioned embodiments, and is acceptable as long as it is provided in the vicinity of at least one of the anode exhaust gas exhaust hole, the cathode exhaust gas exhaust hole, and the cooling medium supply hole. For example, it is also possible to arrange as with modifications 1 and 2 noted below.

FIG. 7 is a plan view showing the schematic structure of the anode side collector plate 30B of modification 1. The anode side collector plate 30B is equipped with a collector unit 38B and the output terminal 39. The collector unit 38B of modification 1 differs from the collector unit 38 of the first embodiment in the arrangement of the cathode gas supply through hole 31, the cathode exhaust gas exhaust through hole 32, the anode gas supply through hole 33, the anode exhaust gas exhaust through hole 34, and the cooling water supply through hole 35. The output terminal 39 is provided in the vicinity of the cooling water supply through hole 35 and the cathode exhaust gas exhaust through hole 32. Even with this arrangement, it is possible to heat the vicinity of the cooling water supply through hole 35 and the cathode exhaust gas exhaust through hole 32 at which flooding occurs easily, so it is possible to suppress the occurrence of flooding.

FIG. 8 is a plan view showing the schematic structure of the anode side collector plate 30C of modification 2. The anode side collector plate 30C is equipped with a collector unit 38C and output terminals 391 and 392. The collector unit 38C of modification 2 differs from the collector unit 38 of the first embodiment in its arrangement of the cathode gas supply through hole 31, the cathode exhaust gas exhaust through hole 32, the anode gas supply through hole 33, the anode exhaust gas exhaust through hole 34, and the cooling water supply through hole 35. The output terminal 391 is provided in the vicinity of the anode exhaust gas exhaust through hole 34, and the output terminal 392 is provided in the vicinity of the cathode exhaust gas exhaust through hole 32. Even arranged in this way, it is possible to use the heat emission at the output terminals 391 and 392 to heat the vicinity of the anode exhaust gas exhaust through hole 34 and the cathode exhaust gas exhaust through hole 32 for which flooding occurs easily, so it is possible to suppress the occurrence of flooding.

#### C2. Modification 2:

With the aforementioned embodiments, with the cathode side collector plate 50, the output terminal 59 is provided at a position facing opposite the position of the output terminal 39 of the anode side collector plate 30. The position of the output terminal 59 of the cathode side collector plate 50 can also be a position that does not correspond to the position of the output terminal 39. For example, it is possible to provide it in

the vicinity of the anode gas supply through hole 33. Even when arranged in this way, it is possible to suppress flooding at the anode side of the single cell 40 arranged near the anode side collector plate 30, so it is possible to suppress degradation of the catalyst.

#### C3. Modification 3:

With the aforementioned second embodiment, by making the plate thickness at the high electrical resistance area 37 thinner than the remaining area, the electrical resistance per unit of length is greater. It is also possible to make the electrical resistance per unit of length of the high electrical resistance area 3y greater using another method. For example, it is also possible to use a material with a specific resistance (electrical resistivity) greater than that of the remaining area for the high electrical resistance area 37. Even when arranged in this way, it is possible to suppress the occurrence of flooding by heating the area for which flooding occurs easily.

#### C4. Modification 4:

With the aforementioned embodiments, it is also possible to have the width of the output terminal 39 of the anode side collector plate 30 be narrower than the width of the output terminal 59 of the cathode side collector plate 50. When arranged in this way, the electrical resistance with the output terminal 39 of the anode side collector plate 30 is greater than the electrical resistance with the output terminal 59 of the cathode side collector plate 50. Because of that, the temperature in the vicinity of the output terminal 39 of the anode side collector plate 30 is higher than the temperature in the vicinity of the output terminal 59 of the cathode side collector plate 50. As a result, with the fuel cell stack 100, in particular, it is possible to suppress anode side flooding with the single cells near the end part of the anode side, making it possible to suppress degradation of the catalyst.

### DESCRIPTION OF PARTS

10 End plate  
20, 20A Insulation plate  
30, 30A, 30B, 30C Anode side collector plate  
31 Cathode gas supply through hole  
32 Cathode exhaust gas exhaust through hole  
33 Anode gas supply through hole  
34 Anode exhaust gas exhaust through hole  
35 Cooling water supply through hole  
36 Cooling water exhaust through hole  
37 High electrical resistance area  
38, 38A, 38B, 38C Collector unit  
39, 391, 392, 59 Output terminal  
40 Single cell  
42 Sealing member single unit type MEA  
44 Anode side separator  
46 Cathode side separator  
50 Cathode side collector plate  
60 Insulation plate  
70 End plate  
100 Fuel cell stack  
400 Stacked body  
421 MEA  
422 Sealing member  
423 Electrolytic membrane  
424 Anode  
425 Anode side diffusion layer  
426 Cathode

9

427 Cathode side diffusion layer  
 441 Anode gas flow path  
 442 Cooling water flow path  
 461 Cathode gas flow path

What is claimed is:

1. A fuel cell stack comprising:

a stacked body constituted by stacking a plurality of power generating elements, which contain an electrolytic membrane and electrocatalytic layers arranged respectively at the anode side and the cathode side of the electrolytic membrane, via a separator for providing a flow path for supplying reaction gas to the electrocatalytic layer, and

collector plates arranged at both ends of the stacked body, for collecting electricity generated by the stacked body and outputting it to the outside, wherein

on the separator and the collector plate are formed an anode gas supply hole for supplying reaction gas to the anode, a cathode gas supply hole for supplying reaction gas to the cathode, an anode exhaust gas exhaust hole for exhausting anode exhaust gas, a cathode exhaust gas exhaust hole for exhausting cathode exhaust gas, a medium supply hole for supplying into the stacked body

10

a medium for maintaining the temperature of the stacked body at an approximately fixed level, and a medium exhaust hole for exhausting the medium from the stacked body,

and at the anode side collector plate arranged at the anode side end of the stacked body,

an output terminal for outputting at least part of the collected electricity to the outside is provided at a position closer to the anode exhaust gas exhaust hole, the cathode exhaust gas exhaust hole, and the medium supply hole than the anode gas supply hole, the cathode gas supply hole, and the medium exhaust hole.

2. A fuel cell stack according to claim 1 wherein the anode side collector plate has a high electrical resistance area for which the electrical resistance per unit of length at a specified position of the output terminal side is in part greater than that of the remaining part.

3. A fuel cell stack according to claim 2 wherein with the high electrical resistance area, by forming the plate thickness of the anode side collector plate to be in part thinner than the remaining part, the electrical resistance per unit of length becomes greater.

\* \* \* \* \*